

A Phenomenological Constitutive Model
for
Rigid Polymeric Foam

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Abstract

Keywords: Foam, Polymer, Viscoplasticity, Impact, Orthotropy

An orthotropic rate independent plasticity and viscoplasticity constitutive law for rigid low density polymeric foams is presented. The multi-surface yield criterion used in the constitutive model represents the envelope of failure surfaces given by Gibson et. al. for cellular materials. The inelastic flow direction was chosen to simulate the near zero "plastic Poisson's ratio" observed in many experimental tests. A special orthotropic hardening law was developed that captures the extreme stiffening due to densification at very large strains. Details involving loading and unloading conditions and discrete algorithms for numerical implementation are discussed. A power law version of the Duvaut-Lions viscoplasticity formulation was used to provide rate dependent behavior. The model is implemented in the finite element code DYNA3D and is used to simulate experimental results from uniaxial compression tests of an orthotropic specimen and drop test impact loadings.

Classification Level: Unclassified

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract No. W-7405-Eng.48.